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ABSTRACT

Most teachers agree that the mathematics skills needed for today's world encompass more than basic computation. It is important that schools provide students with the skills to organize and analyze the wealth of information that confronts them on a daily basis. Therefore, the quantitative reasoning skills required for intelligent problem solving must be an integral part of the school mathematics curriculum. Problem solving is a skill that can be enhanced by students who use the newspaper as a part of their mathematics instruction. Newspapers supply information that students can analyze, interpret, and apply to everyday problems. This publication provides secondary mathematics teachers with a series of meaningful activities that use the newspaper as a learning resource. The activities are designed to provide experiences in: (1) several important skill areas by cultivating an awareness of mathematics which should result in increased motivation; (2) the understanding of numerical concepts; (3) "real-life" applications of mathematics; (4) working with data using tables, charts, or graphs; (5) concepts of probability; and (6) geometry and measurement. Included in this publication is a brief discussion of the purposes of mathematics education, the advantage of using the newspaper, and the relationship between the two. (RT)

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Using the Newspaper

in Secondary Mathematics

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Using the Newspaper in
Secondary Mathematics

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Preface

The purpose of this brief publication is to provide secondary mathematics teachers with a series of meaningful activities that use the newspaper as a learning resource. Included in this document is a brief discussion of the purposes of mathematics education, the advantages of using the newspaper as a resource and the relationship between the two.

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What is basic in school mathematics?

It would be difficult to reach a consensus on the answer to the question of what is basic in school mathematics. On one point, however, most teachers agree: the mathematical skills needed for today's world encompass much more than basic computation. Vast amounts of data characterize our "information age." Thus, it is essential that schools provide students with the ability to organize and analyze the wealth of information that confronts them on a daily basis. The quantitative reasoning skills required for intelligent problem solving must become an integral part of the school mathematics curriculum.

Although there are many opinions as to what are basic skills in mathematics, two documents that address this question have received greater attention than any others; these documents provide the framework for the discussion that follows. "Position Paper on Basic Skills" of the National Council of Supervisors of Mathematics (NCSM) and *An Agenda for Action* of the National Council of Teachers of Mathematics (NCTM) have been influential on issues related to mathematics curricula. Many recommendations made by these publications appear in currently used textbooks and other resources for teaching mathematics.

According to the National Council of Supervisors of Mathematics, basic skills in mathematics include:

PROBLEM SOLVING. Learning to solve problems is the principal reason for studying mathematics. Problem solving is the process of applying previously acquired knowledge to new and unfamiliar situations. Solving word problems in texts is one form of problem solving, but students also should be faced with non-textbook problems. Problem-solving strategies involve posing questions, analyzing situations, translating results, illustrating results, drawing diagrams and using trial and error. In solving problems, students need to be able to apply the rules of logic necessary to arrive at valid conclusions. They must be able to determine which facts are relevant. They should be unfearful of arriving at tentative conclusions and they must be willing to subject these conclusions to scrutiny.

APPLYING MATHEMATICS TO EVERYDAY SITUATIONS. The use of mathematics is interrelated with all computation activities. Students should be encouraged to take everyday situations, translate them into mathematical expressions, solve the mathematics and interpret the results in light of the initial situation.

ALERTNESS TO REASONABLENESS OF RESULTS. Arithmetic errors or other mistakes occasionally make the results of mathematical work wrong. Students should learn to inspect all results and to check for reasonableness in terms of the original problem. With the increase in the use of calculating devices in society, this skill is essential.

ESTIMATION AND APPROXIMATION. Students should be able to carry out rapid approximate calculations by first rounding off numbers. They should acquire some simple techniques for estimating quantity, length, distance, weight, etc. They should be able to decide when a particular result is precise enough for the purpose at hand.

APPROPRIATE COMPUTATIONAL SKILLS. Students should gain facility with addition, subtraction, multiplication and division with whole numbers and decimals. Today it must be recognized that long, complicated computations will usually be done with a calculator. Knowledge of single-digit number facts is essential and mental arithmetic is a valuable skill. Moreover, there are everyday situations that demand recognition of and simple computation with common fractions. Because consumers continually deal with many situations that involve percentages, the ability to recognize and use percentages should be developed and maintained.

GEOMETRY. Students should learn the geometric concepts they will need to function effectively in the three-dimensional world. They should have knowledge of concepts such as point, line, plane, parallel and perpendicular. They should know basic properties of simple geometric figures, particularly those properties that relate to measurement and problem-solving skills. They also must be able to recognize similarities and differences among objects.

MEASUREMENT. As a minimum skill, students should be able to measure distance, weight, time, capacity and temperature. Measurement of angles and calculations of simple areas and volumes are also essential. Students should be able to perform measurement in both metric and customary systems using the appropriate tools.

READING, INTERPRETING AND CONSTRUCTING TABLES, CHARTS AND GRAPHS. Students should know how to read and draw conclusions from simple tables, maps, charts and graphs. They should be able to condense numerical information into more manageable or meaningful terms by setting up simple tables, charts and graphs.

USING MATHEMATICS TO PREDICT. Students should learn how elementary notions of probability are used to determine the likelihood of future events. They should learn to identify situations where immediate past experience does not affect the likelihood of future events. They should become

familiar with how mathematics is used to help make predictions, such as election forecasts.

COMPUTER LITERACY. It is important for all citizens to understand what computers can and cannot do. Students should be aware of the many uses of computers in society, such as their use in teaching and learning, financial transactions and information storage and retrieval. . . Persons with no understanding of computers may be at a disadvantage. Thus, the increasing use of computers by government, industry and business demands an awareness of computer uses and limitations.*

That the NCSM publication identifies problem solving as "the principal reason for studying mathematics" is noteworthy. Clearly, problem solving is interpreted by that publication to include skills ranging from organizing and analyzing information to those more commonly associated with solving typical textbook word problems. Also noteworthy is NCSM's label of "basic" to a range of other quantitative reasoning skills—alertness to reasonableness of results, estimation and approximation and applying mathematics to everyday situations. Facility in computation, according to NCSM, is no longer sufficient preparation in mathematics for effective decision making (if indeed, it ever was).

The NCSM list of basic skills in mathematics was an important source document for the authors of *An Agenda for Action,* a set of recommendations on school mathematics for the 1980s, published by the National Council of Teachers of Mathematics. Covering a number of important aspects of mathematics education, *An Agenda for Action* recommends that:

1. Problem solving be the focus of school mathematics in the 1980s
2. Basic skills in mathematics be defined to encompass more than computational facility
3. Mathematics programs take full advantage of the power of calculators and computers at all grade levels
4. Stringent standards of both effectiveness and efficiency be applied to mathematics teaching
5. The success of mathematics programs and student learning be evaluated by a wider range of measures than conventional testing
6. More mathematics study be required for all students and a flexible curriculum with a greater range of options be designed to accommodate the diverse needs of the student population
7. Mathematics teachers demand of themselves and their colleagues a high level of professionalism
8. Public support for mathematics instruction be raised to a level commensurate with the importance of mathematical understanding to individuals and society.

Recommendations 1, 2 and 4 are amplified in the paragraphs that follow with brief explanations. These recommendations, clearly relevant to a discussion of basic skills in mathematics, suggest that the newspaper can and should be considered a resource in teaching these basic skills.

RECOMMENDATION 1: Problem solving must be the focus of school mathematics in the 1980s.

The mathematics curriculum should be organized around problem solving.

Mathematics programs in the 1980s must be designed to equip students with mathematical methods that support the full range of problem-solving techniques, including traditional concepts of computation and applications of mathematics to real-world problems . . . (and) methods of gathering, organizing and interpreting information, drawing and testing inferences from data and communicating results.

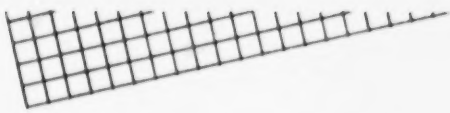
Mathematics programs should give students experience in applying mathematics, in selecting and matching strategies to the situation at hand. Students must learn to formulate key questions, analyze and conceptualize problems, define problems and goals, discover patterns and similarities, seek out appropriate data, experiment, transfer skills and strategies to new situations and draw on background knowledge.

The definition and language of problem solving in mathematics should be developed and expanded to include a broad range of strategies, processes and modes of presentation that encompass the full potential of mathematical applications.

The mathematics curriculum should provide opportunities for students to confront problem situations in a greater variety of forms than traditional verbal formats alone; for example, presentation through activities, graphic models, observation of phenomena, schematic diagrams, simulation of realistic situations and interaction with computer programs.

Most current materials strongly emphasize an algorithmic approach to learning mathematics, and as such they are inadequate to support or implement fully a problem-solving approach. Present textbook

*Adapted from: National Council of Supervisors of Mathematics, "Position Paper on Basic Skills," *Arithmetic Teacher* 25 (October 1977): 19–22.



problems tend to be easily categorized and stylized and often bear little resemblance to highly diversified, real-life problems. They do not permit the full range of strategies and abilities actually demanded in realistic problem contexts.

Applications should be presented that use the student's growing and changing repertoire of basic skills to solve the multitude of routine and commonplace problems that make up day-to-day living.

RECOMMENDATION 2: Basic skills in mathematics must encompass more than computational facility.

Changes in priority and emphasis in the instructional program should be made in order to reflect the expanded concept of basic skills. There should be increased emphasis on activities such as locating and processing quantitative information, collecting data, organizing and presenting data, interpreting data, drawing inferences and predicting from data and using ratio and proportion to deal with rate problems in general and with percent problems in particular.

Teachers should provide ample opportunity for students to learn communication skills in mathematics. They should systematically guide students to read mathematical information accurately and to talk about it with clarity.

RECOMMENDATION 4: Stringent standards of both effectiveness and efficiency must be applied to mathematics teaching.

Teachers should use diverse instructional strategies, materials and resources.*

There is clear agreement between the NCSM position paper on basic skills and NCTM's *An Agenda for Action* on areas of the mathematics curriculum that should be emphasized. The importance attached to problem solving in its broadest sense is evident, as is the attention given to applications of mathematics, probability, statistics and other general skills associated with quantitative reasoning. In the discussion that follows, using the newspaper as a resource to supplement instruction in several of these curricular areas will be addressed.

The newspaper and secondary mathematics

Clearly, problem solving must be considered a basic skill in mathematics. It is, moreover, a skill that can be appreciably sharpened by students who use the newspaper as part of their mathematics instruction. Newspapers are current and up-to-date sources of data —they supply information that students may want to analyze, interpret and apply to solutions of everyday problems (e.g., determining sales prices or discounts). Indeed, newspapers in the classroom will help students understand just how a facility with mathematics will be an asset throughout life.

One important aspect of problem solving as a basic skill is learning what questions can be asked, based on a given set of information. Newspapers produce many settings in which this skill can be practiced. To name just one: using a sports page's weekly summation of football scores and league standings, students could easily ask which team scored the most points or which occupied first place in its division, but might not be able to tell which quarterback was "sacked" most frequently or which game saw the most turnovers. Teachers who analyze sports scores in this way with their students will help students recognize that some questions may be unanswerable because the data provided are insufficient or extraneous. Among the things that the newspaper can teach students, then, is that knowing how to ask the right questions may be as important a skill as being able to answer questions already asked.

Newspapers are full of opportunities for students to grapple with real-world problems. Coupons offering reduced prices, quantity purchases or cash rebates can serve as models for traditional computation exercises or in more non-traditional ways. (For example, to reinforce the concept of variables, students can translate price information into symbolic representation; thus, if A is the original price of an item and $1.00 is the amount discounted, then $A - \$1.00$ is the discounted price.) Or students might locate examples of different uses of numbers. What they will

*Recommendations adapted from: National Council of Teachers of Mathematics, *An Agenda for Action*, Reston, Va., 1980, pp. 1-13.

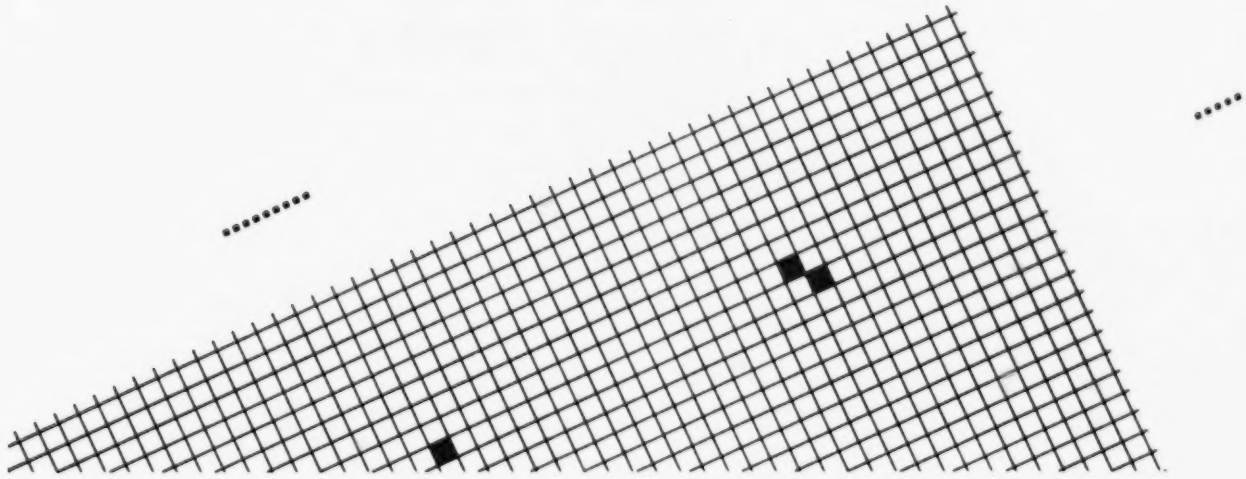
quickly learn is that numbers can be used to categorize, order, express rates, express quantities (including very large and very small amounts), express locations and so forth. Additionally, students could be directed to search for examples of environmental applications of mathematics (such as population/food supply statistics) or expressions of natural laws (such as those discussed in articles about space travel). The examples are endless.

The recommendation from *An Agenda for Action* that "teachers . . . provide ample opportunities for students to learn communication skills in mathematics" can be addressed, at least in part, through the use of the newspaper. Much of the information presented in the newspaper is quantitative, and thereby provides a natural medium for mathematically oriented classroom discussion. Data from the sports page, weather news, financial pages, want ads or front page news items can provide many opportunities for communication about mathematical ideas—and will do so at high interest to the students.

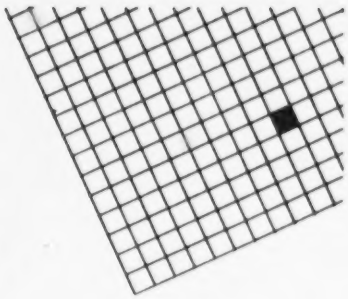
Both the NCSM list of basic skills and *An Agenda for Action* highlight the importance of students being able to read, interpret and construct charts, tables and graphs. Even a cursory look at any newspaper underscores the importance of this skill. Statistics that relate to every aspect of life appear on a daily basis. Unemployment figures, crime rates, taxes, inflation, weather, sports, the consumer price index, the gross national product, the national budget, birth rates and this week's "Top 40" hits are all there. Using the newspaper in class is an excellent way to show students why they need to be familiar with the concepts of descriptive statistics, and will provide many examples with which they can develop this familiarity.

In fact, skills associated with being able to read, interpret and construct tables, graphs and charts include developing an awareness of how data can be presented in misleading forms or how statistics can be misinterpreted. Although it may be painful for their editors to admit, newspapers occasionally supply good examples of the way statistics can be misused or poorly presented. Students might be able to locate examples of misleading numerical terminology in advertisements (what is meant by "four out of five doctors recommend . . ."?) or in unclear graphical presentations of data. Such examples can lead to discussions of accurate sampling, cause/effect relationships and concepts of probability.

Perhaps the most important point to be made as the newspaper is considered as a resource for mathematics education is a plea to teachers: Be open to the many ways you can teach math to your students. The newspaper can enlarge the horizons of students in school, and can expand their notions of what are appropriate activities for practicing quantitative reasoning skills. In line with the recommendations of the NCSM and the NCTM, we should not limit our students' mathematical problem-solving skills to traditional computation, but should expand our thinking to include the types of skills they will need to function effectively in the information age.



About the activities



The preceding discussion suggests several important skill areas that should be emphasized in secondary school mathematics. No longer is work in computation—at the expense of other skills—sufficient to prepare students to function in today's world. Students need to learn a broad range of quantitative skills, including those associated with problem solving, estimation and approximation, organization and analysis of data and real-life applications of mathematics. The activities that follow are designed to take advantage of the newspaper as a resource that will give students experience in several of these important skill areas.

Cultivating an awareness of mathematics

The activities in this section are to be used to help students understand the many everyday uses of mathematics and to broaden their exposure to the range of concepts called "mathematics." Allowing students to see a variety of contexts within which mathematics is used should result in increased motivation to learn the subject matter and develop comfort with it.

Have students locate symbols, abbreviations, numerals and words from the newspaper that relate to mathematics.

Have students clip an advertisement from the newspaper and create an original mathematics problem. Students should exchange and solve the problems.

Have students identify headlines that use numbers or mathematical concepts.

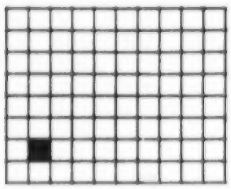
Have students make collages, posters or bulletin boards using mathematical symbols or concepts from the newspaper.

Have students select a news article of interest from the newspaper and explain how knowledge of mathematics makes it easier to understand the story.

Have students use the newspaper to identify careers available in mathematics or careers that require a knowledge of mathematics.

Numbers

An understanding of the concept of number is fundamental to mathematics. Learning how to express quantities with numbers and how to perform operations on those numbers occupies much of the elementary and middle school mathematics curriculum. Students are given opportunities to work with different types of numbers (e.g., whole numbers, fractions, percents), and to learn about different uses of numbers (e.g., to count, to measure, to express relationships). Since newspapers are full of such examples, the following activities will provide a variety of experiences with these different aspects of numerical concepts.



DIFFERENT TYPES OF NUMBERS

Have students look for as many examples of different types of numbers (e.g., whole numbers, fractions, decimals, percents, integers) as they can find. Are different types of numbers used in different contexts?

Have students identify fractions and decimals in the newspaper. Have them determine which are more commonly used and why.

Look for examples of very large or very small numbers. (To name one: the national budget deficit, now approaching $200 billion.) So that students will understand just how much money one billion dollars represents, have them calculate how long it would take to spend a billion dollars, spending $1 per second.

Have students identify references to large numbers in the newspaper. Have them display different ways to write each of the numbers (1,500,000; 1.5 million; 1½ million).

Have students identify, from the front page of the newspaper, articles that contain numbers in their lead paragraphs. Have students try to rewrite the paragraphs without using numbers.

DIFFERENT USES OF NUMBERS

Have students find as many examples of numbers used in different ways as they can. For example, numbers may represent counts, order, size, scale, descriptions, measures, etc.

Have students examine the newspaper and find examples of proportions and ratios.

"Real-life" applications of mathematics

One of the goals of school mathematics is to teach students how to solve problems. "Problem solving" is a comprehensive term that includes a range of skills and a variety of situations. In fact, many students judge the importance of mathematics as a school subject in terms of its usefulness in solving everyday problems.

Not only is it important for students to know how to perform the computations necessary to solve real-life mathematical problems, the availability of calculating devices makes it more important than ever for students to be skilled in making estimations and approximations. Of equal importance are skills related to expressing quantitative relationships and making decisions based on the results of computations. The activities in the following section are designed to address all of these crucial skills.

COMPUTATIONS WITH WHOLE NUMBERS, FRACTIONS, DECIMALS AND PERCENTS
(Use of calculators is encouraged.)

Have students read, collect, discuss and present to the class articles and other information from the newspaper related to practical applications of mathematical concepts and skills. This activity should be on-going because it relates to the importance of "real-life referents" for mathematical skills and concepts.

Have students select items from the newspaper that they would like to own. Have them figure the total cost of the items, including sales tax.

Have students locate 10 items for sale in newspaper ads. Have them figure the difference between the regular price and the sale price and the percent of savings.

Give students the price per word and per day for classified advertisements in the newspaper. Have them compute the cost of various ads for various lengths of time.

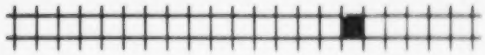
Have students double or halve the yield of recipes printed in the newspaper by increasing or decreasing the ingredients used.

Have students identify a new car advertised in the newspaper that they would like to own. Have them establish what they might pay as down payment and then calculate the balance due and monthly payments, using prevailing interest rates. Repeat this activity with ads for houses.

Have students compute and compare interest rates from newspaper ads for banks and saving and loan associations.

Have students identify classified ads that list both price and square footage of three houses for sale. Have students compute the price per square foot for each house.

Have students examine advertisements in a current newspaper and in a newspaper printed five or 10 years ago. (You may need to contact either your local newspaper or your local library for the old newspapers.) Compare the cost of selected items and compute the percent of change.



Have students read restaurant ads in the newspaper and compute, if possible from the information given, the cost of a meal for a family of four. If discount coupons are available, compute the savings realized.

Have students examine ads that give expected miles-per-gallon (mpg) for various models of automobiles. Have them select a place to visit and compute gasoline costs for at least five different automobiles.

Have students identify newspaper ads for interior or exterior paint. Have them compute the cost of painting a room, house or even the classroom. They can follow the same procedure to determine the cost of fertilizing a lawn.

Have students use food ads to determine the cost of multiple units of advertised items. Students can cut out ads and devise problems for classmates to solve.

Have students examine the exchange rates of foreign currency identified in the newspaper. Have students convert foreign currencies to equivalent dollar amounts.

ESTIMATION AND APPROXIMATION SKILLS

Have students look for examples of rounded numbers or the term "approximately" in reference to numbers denoting quantities.

With activities similar to those in the previous section, have students estimate answers to computation exercises before the computations are performed. How close did they come to estimating the answer? How much error is acceptable in estimation or approximations?

COMPUTATIONS THAT INVOLVE DECISION MAKING

Have students use newspaper advertisements to calculate the per ounce price of an item. Then have students compare the per ounce (or unit) price of two different-sized packages of that item. Which is most economical?

Using a list of at least 10 items, have students read newspaper ads to compare prices from different stores and identify the stores in which they will get the best buy.

Have students use newspaper ads and plan a dinner for a family of five. They should compute the total cost of the meal.

Allow students to take an imaginary trip, with only a fixed sum of money. Have them plan the cost of transportation, accommodations, meals, entertainment, etc.

EXPRESSING QUANTITATIVE RELATIONSHIPS

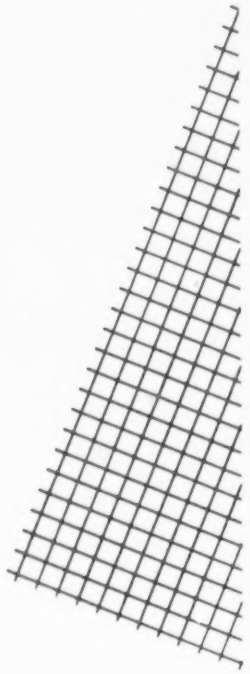
Have students identify articles that include numbers representing relationships of less than, equal to or greater than.

Have students look for examples of formulas to express quantitative relationships (e.g., determination of gross national product, the consumer price index, earned run averages).

Have students practice expressing relationships that involve variables (translating information into symbolic representation). For example, using coupons that show 25¢ off the regular price of a product and allowing *P* to represent the original price, what is the proper expression for the price of the item with the coupon? (P − $.25)

Working with data

Today we live in what has been labeled an "information age." Not only is knowledge growing at an increasing rate, the amount of information made available to the general public is increasing proportionately. This suggests that skills related to the organization and analysis of data are assuming increased importance in the school mathematics curriculum. Students must learn how to "make sense" out of information presented in tables, graphs or charts and should be able to construct appropriate modes of displaying data. They must learn to read and interpret given information, and be able to draw inferences from that information. Concepts related to descriptive and inferential statistics are also fundamental to students' successful functioning in an information-based society. The activities that follow will provide experience in all of these areas.



ORGANIZING AND ANALYZING GIVEN INFORMATION FROM TABLES, CHARTS OR GRAPHS

Note: Before you begin this section, you may want to skim several issues of your daily newspaper for charts, graphs and tables. The examples listed below are just that—examples, written to give you an idea of the many ways you can use items found in the newspaper to suit your students' needs. You should of course feel free to devise your own exercises, based on the graphic presentations of data you find in the newspaper.

Have students identify and explain various graphs found in different sections of the newspaper (e.g., bar, line, circle).

Have students read information contained in tables, graphs or charts. For example, which year showed the greatest number of housing starts? (And what is meant by the phrase "housing starts"?)

Have students make interpretations from information contained in tables, charts or graphs. For example, between which two decades was there the greatest decline in unemployment?

Have students make interpolations from information contained in tables, graphs or charts. For example, if the present birth rate in India continues, when will the population exceed the habitable available space?

Have students construct graphs of data contained in tabular form. Which type of graph is best for different types of data?

Have students read an article that includes statistical information. Have them use the statistics to construct a graph that could accompany the article.

Have students assume that they have a certain amount of money to invest in the stock market. They should "purchase" at least five different stocks and chart daily gains and losses.

Have students construct graphs to illustrate vital statistics found in the newspaper, such as births, deaths, marriages, divorces, police and fire calls.

Have students graph weather information found in the newspaper (highs and lows, precipitation, temperature extremes, etc.)

Have students examine travel ads for airline fares to various cities. Have them develop a graph to show the fares and cost-per-mile to those cities.

CONCEPTS OF STATISTICS

Have students look for examples of different uses of statistical terms such as "average" and "median."

Have students examine and use statistics found on the sports pages to make mathematics problems meaningful. For example, students can use sports data to compute batting averages, a team's won and loss percentage, etc.

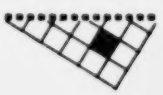
Have students compute the average price of 10 different apartments, houses, cars or other similar items in the newspaper. Then have students figure the median price.

Have students identify and compute average salaries for different types of jobs.

Have students look for examples of misuses of statistics. For instance, using the mean as the measure of central tendency when the median is more appropriate, using pictorial representations of data that misrepresent quantities, and so on.

Have students locate and interpret examples of advertisements containing phrases such as "4 out of 5 dentists recommend . . ." (This activity leads naturally into discussions of sampling.)

Have students design and conduct an opinion survey of some kind and tabulate the results. They should report the results in a brief news story with accompanying graphs.



Probability

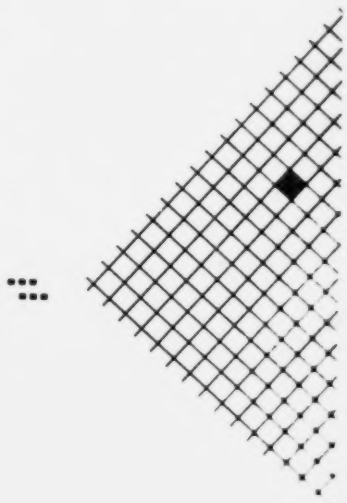
Students need formal experience with concepts of probability such as random selection and odds in order to counter misconceptions that often arise in conjunction with these concepts. Probabilistic statements are easily found in all sections of the newspaper, and provide a variety of contexts in which these concepts apply.

Have students look for examples of probabilistic statements: "Chances of rain are . . . ," "The likelihood is . . . ," "On the average . . . ," "The odds are." What do such expressions mean? Are these terms always used in mathematically correct ways?

Have students look for examples of predictions based on relatively small samples. How does probability theory enter into these predictions?

Geometry and measurement

Concepts of informal geometry that deal with shapes and properties of shapes are an integral part of the school mathematics curriculum. Measurement concepts are also often associated with the study of shapes. Since these ideas are fundamental to so many mathematical applications, it is important that students be given experience with these topics in real-life settings. The newspaper can provide many examples of the use of geometric and measurement concepts in applied form.



Have students identify different units of measurement found in the newspaper.

Have students collect articles that make reference to the metric system. Have them convert measurements in the newspaper to the metric system.

Have students identify as many different geometric shapes from the newspaper as possible.

Have students read the newspaper and identify at least 10 different measurements. They should identify the type of measure and the context in which it was used.

Have students select a favorite professional sports team. Using a map, have them compute the number of miles their team will travel to games during a specified period of time. Students can report their findings to the class in order to determine which team had the greatest distance to travel.